# Space Weather Technical Forecast

Issued on Thursday, 19 October 2023 at 01:15 Local

**This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales**

**Space Weather Forecast Headline: Weak CME arrivals possible, with a slight chance of isolated G1/Minor Geomagnetic Storm intervals throughout.**

**Analysis of Space Weather Activity over past 24 hours**

**Solar Activity:** Low, with the only notable flare being a double peak C1.6 from a region beyond the northwest limb at 18/0213 UTC. There are currently three numbered regions on the visible disc and two unnumbered regions, all of which are relatively small and simple, and either stable or in decline.

Two CMEs of note were observed in imagery. The one to the northwest has been assessed as far-sided. The less bright CME to the southeast, associated with an eruption to the south of AR3468, has been assessed as likely missing, passing behind and south of Earth, but with a slight chance of glancing impact either late day 3 or early day 4 (21-22 Oct)

**Solar Wind / Geomagnetic Activity:** A weak enhancement occurred due to the onset of CH60/+ fast wind, with a lower confidence potential that this included some element of either, or both, weak CME's from 14 Oct. The solar wind speed at L1, measured by ACE and DSCOVR, gradually rose from below 300km/s, before spiking upwards at 18/0844UTC to over 350km/s, then rising erratically to peak slightly elevated at 480km/s by 18/1445 UTC. Winds then gradually eased to near 400km/s. The density was above average before the spike in speed at 18/0844 UTC, then fell to be below average. Interplanetary magnetic field (IMF), Bt, was predominantly weak, below 7nT, but erratically increased with a period of more moderate values 18/1000-1400 UTC, peaking 13 nT. The north-south component, followed a similar pattern, but initially positive (northward), before becoming predominately negative (southward) from 18/1000 UTC, ranging between +8 and -10nT. Phi angle was positive (away from the Sun). Geomagnetic activity was Quiet to Unsettled (Kp 0-3).

**Energetic Particles / Solar Radiation:** GOES16 high energy (greater than 10MeV) proton flux was at Background. GOES16 high energy (greater than 2MeV) electron flux was at Background throughout. Associated 24-hour fluence was well below the Active (1e8 integrated pfu) threshold. The observation at 19/0000UTC was 1.65e6 integrated pfu.

**Four-Day Space Weather Forecast Summary**

**Solar Activity:** Low to Very Low activity expected. There is a slight, but perhaps increasing chance of isolated M-flares through the period with any development that occurs on the disc.

**Solar Wind / Geomagnetic Activity:** There are three CMEs with potential Earth impacts, however all are low confidence. The most likely arrival would be late day 1 or early day 2 (19-20 Oct) from the CME originating with the C7.5 flare on 16 Oct. Further glancing impacts are possible, although less likely late day 2 or day 3 (20-21 Oct) from a filament eruption on 17 Oct, and then again day 3-4 (21-22 Oct) due to the CME from the eruption on 18 Oct. Otherwise current fast winds from CH60/+ are expected to soon ease, but with a potential weak enhancement possible from CH62/- fast winds day 2 (20 Oct) onward, however this is also very low confidence. Overall, mainly Quiet geomagnetic activity is expected with Unsettled intervals. There is a chance for spells of Unsettled to Active with any of the CME arrivals, with a slight

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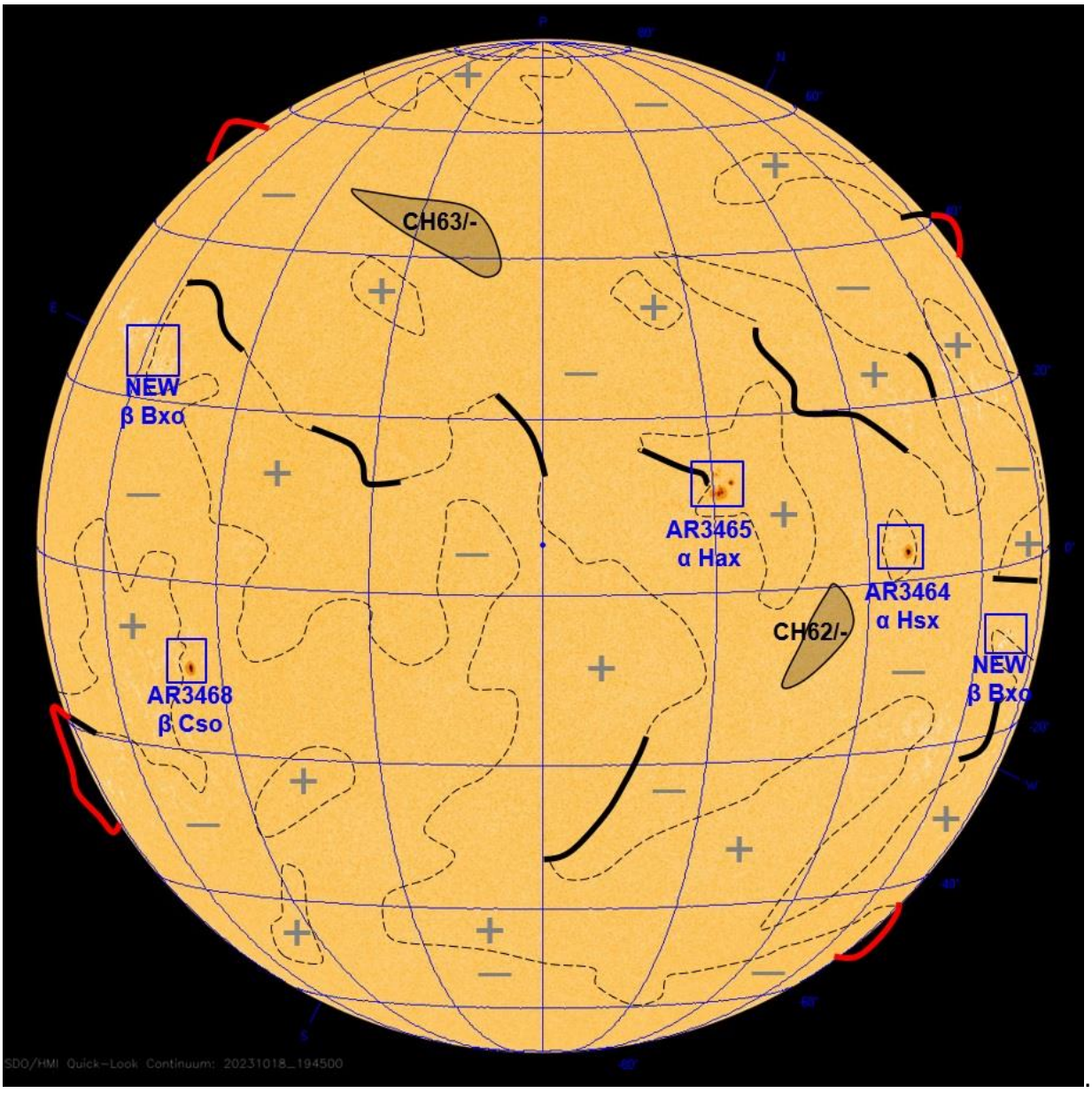
chance of G1/Minor Storm intervals.

**Energetic Particles / Solar Radiation:** High energy (greater than 10 MeV) proton flux is expected to persist at Background. High energy electron flux (greater than 2MeV) is expected to be at Background, perhaps rising to Moderate depending on the strength of any CME sourced enhancement that occurs. The associated 24 hr electron fluence is expected to remain below Active (1e8 integrated pfu)

**Figure 1. Solar Analysis Valid 18/2000 UTC.**




**Key:** Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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## Geomagnetic Storms:

There are a three weak CMEs that have the potential to glance Earth during the period. The main potential for enhancement is now from the CME which left the northeast disc on 16 Oct due to the C7.5 of AR3467. The bulk of the material is modelled to miss, passing behind Earth, but with the chance of a slight glance either late day 1 or early day 2 (19-20 Oct).

A CME was also observed from a filament eruption near ex-AR3463 off the southwest disc early on 17 Oct. This is also expected to largely miss, passing ahead and south of Earth, but with the potential for a glancing impact either late day 2 or early day 3 (20-21 Oct). A further eruption was observed from the southeast disc around 18/0530 UTC, this has been assessed as passing to the south and behind Earth late day 3 or early day 4 (21-22 Oct), also with a slight chance of glancing impacts. All of these glancing blows are considered low confidence.

A further low confidence enhancement is possible from the small coronal hole 62/-. This may also increase winds to around 400 km/s, with MOSWOC Enlil showing the arrival of a CIR region alongside either CMEs glance on day 2. This feature is currently considered unlikely to impact on the forecast however, with the coronal hole much reduced compared to the previous 27-day solar rotation when very little enhancement was observed.

Overall, mainly Quiet geomagnetic activity is expected with Unsettled intervals. There is a chance for spells of Unsettled to Active with any of the CME arrivals, with a slight chance of G1/Minor Storm intervals. These most likely with any CME arrival early on day 2 (20 Oct).

| Geo-Magnetic Storm Probability (Exceedance) | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| Minor or Moderate | G1 to G2 | No | 10 | 15 | 5 | 5 |
| Strong | G3 | No | 1 | 1 | 1 | 1 |
| Severe | G4 | No | 1 | 1 | 1 | 1 |
| Extreme | G5 | No | 1 | 1 | 1 | 1 |

## Geomagnetic Activity - Earthbound Coronal Mass Ejections

| Date/time 21.5R (UTC) | Halo: Full or Partial | Source | Source Location | Estimated Speed | Estimated Arrival Time | Comments |
|---|---|---|---|---|---|---|
| 16/1730 | Partial | C7.5 AR3467 | NE | 680 | 20/0100 UTC | Low confidence Glancing impact |
| 17/1430 | Partial | Filament | SW | 480 | Late 20/Early 21 Oct. (Likely missing) | Very low confidence Glancing impact |
| 18/1132 | Partial | Filament | SE | 610 | Late 21/Early 22 Oct (Likely missing) | Very low confidence Glancing impact |

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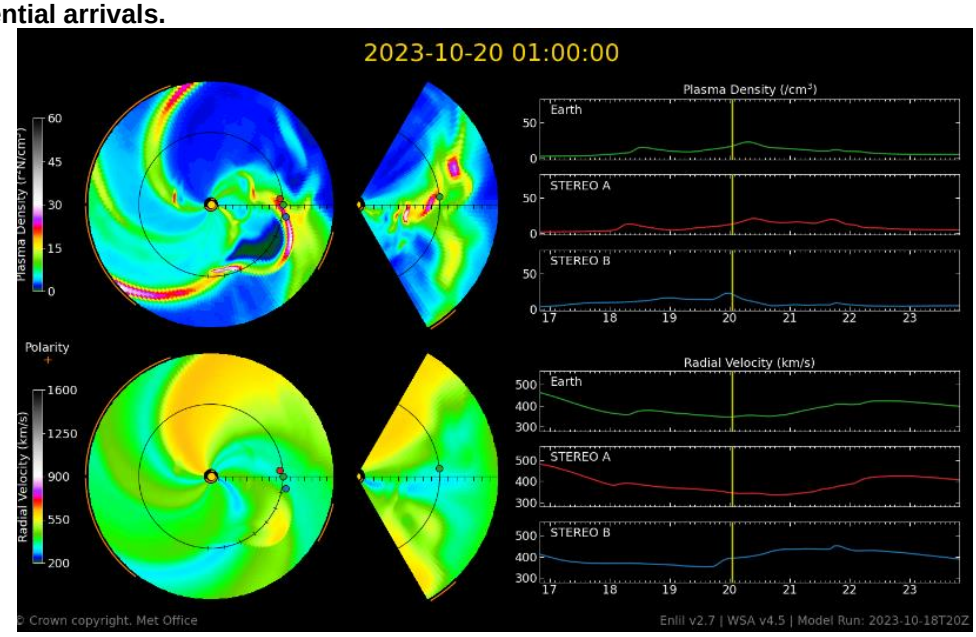
**Figure 2a: MOSWOC Enlil showing potential glance on around 20/0100 UTC and ensemble showing further potential arrivals.**



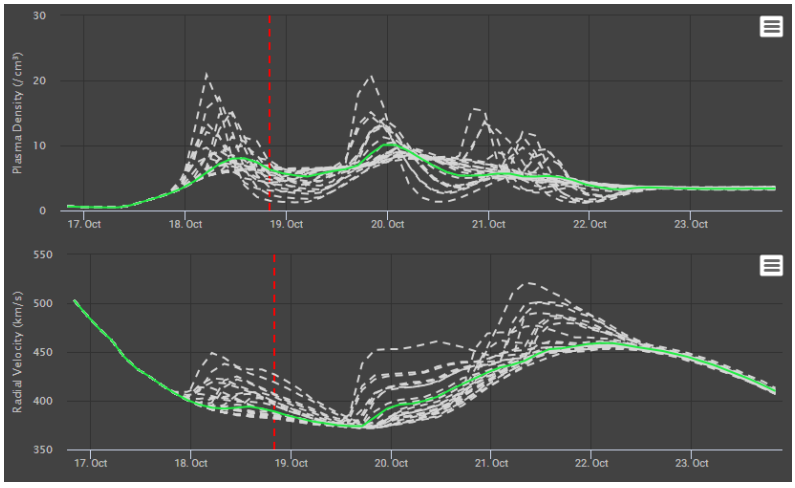
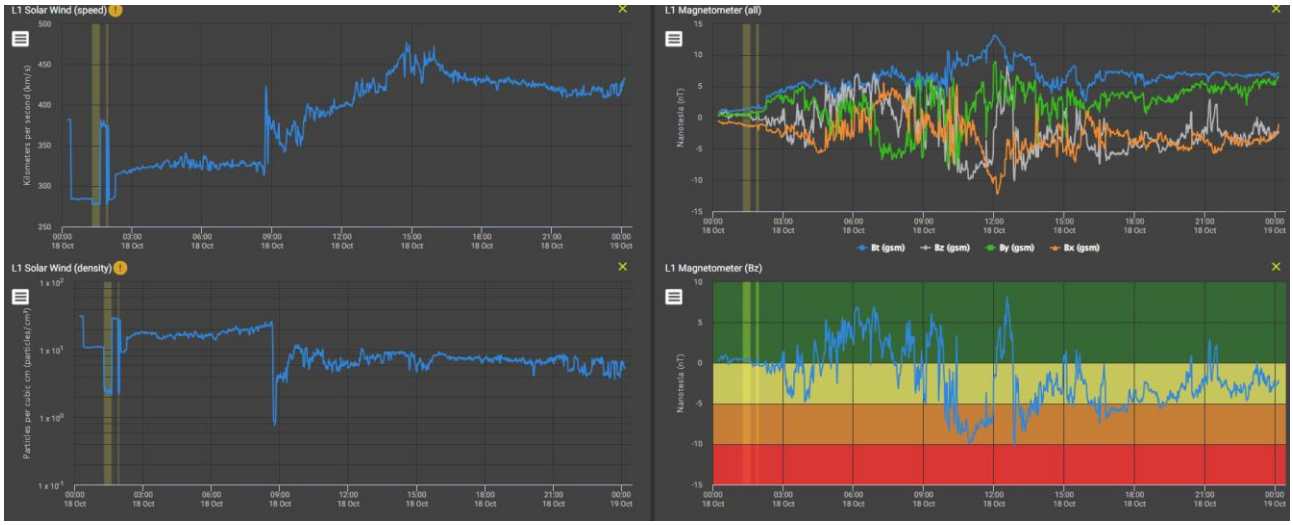




**Figure 2b. Current solar winds, showing weak CH enhancement (and possible CME inclusion).**

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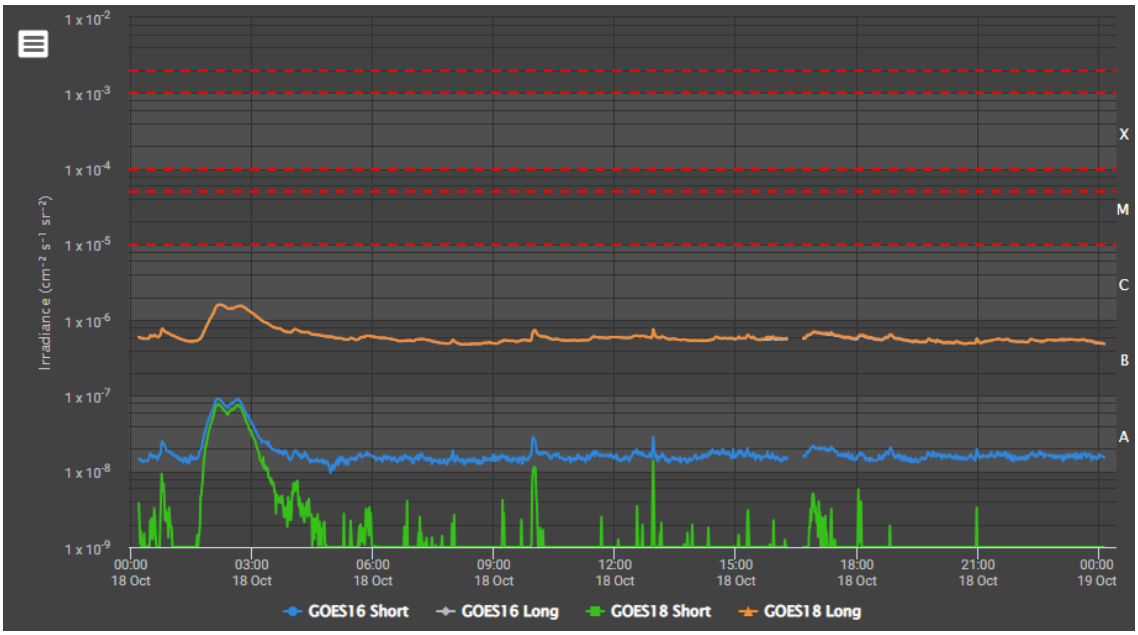
## Radio Blackouts - X-Ray Flares:

Activity is expected to remain Low to Very Low, with only isolated C-class flares likely. There are currently three numbered regions on the visible disc and two unnumbered regions. All the spots on the visible disc are small and simple. There is only a slight chance of M-flares, but likely increasing later in the period as any development occurs.

| X Ray Flares<br>Probability | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC)<br>(%) | Day 2 (00-24 UTC)<br>(%) | Day 3 (00-24 UTC)<br>(%) | Day 4 (00-24 UTC)<br>(%) |
|---|---|---|---|---|---|---|
| Active | R1-R2 M Class | No | 10 | 10 | 20 | 30 |
| Very Active | R3 to R5 X Class | No | 1 | 1 | 1 | 1 |

**Figure 3: GOES 16/18 X-ray flux, showing the lack of recent activity**

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## Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux observed by GOES16 is most likely to persist at Background levels. Any increase to proton flux is unlikely, given the current visible sunspot activity.

| Radiation Storms Probability (Exceedance) | Level ($cm^{-2}$ $sr^{-1}$ $s^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| Active | ≥ S1 | No | 1 | 1 | 1 | 1 |
| Very Active | ≥ S3 * | No | 1 | 1 | 1 | 1 |
| * S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$) | | | | | | |

## High Energy Electrons Event (≥ 2MeV):

Electron flux observed by GOES-16 at GEO is currently at background levels. Solar wind enhancements are possible through the coming days, mainly associated with a number of potential CME arrivals throughout the period, or the onset of a HSS from small coronal hole CH62/- fast wind. These are all low confidence however, and any enhancement is expected to be largely weak. These may increase electron populations through the Van Allen belts at times, which could bring periods of Moderate flux, most likely towards the end of the period.

The associated 24 hour fluence is expected to remain below the Active threshold, although an increasing trend is likely, especially towards the end of the period, depending on the strength of any enhancements that occur. This is supported by REFM, however this will only provide good guidance in the absence of any CME or fast wind enhancements.

| GEO Electron Environment Probability (Exceedance) | Level ($cm^{-2}$ $sr^{-1}$ $day^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| Active | ≥ 2 MeV ≥ $1x10^8$ | No | 1 | 1 | 1 | 5 |
| Very Active | ≥ 2 MeV ≥ $1x10^9$ | No | 1 | 1 | 1 | 1 |

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